

# 2005 Arctic Science Conference

Kodiak, Alaska · September 27th – 29th

## Is the North that Different?

Consequences of Arctic and Sub-Arctic Environmental Variation

# <sup>2005</sup>Arctic Science Conference</sup>

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### Is the North that Different?

Consequences of Arctic and Sub-Arctic Environmental Variation

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#### • Conference Organization •

The Arctic Science Conference is an annual meeting that is organized and supported by the American Association for the Advancement of Science (AAAS) Arctic Division. The locations and themes of the conference vary from year to year, although the themes and locations are always related to the Arctic and the scientific endeavors of the AAAS Arctic Division members and their colleagues. It is a continuing goal of this conference that it be open and accessible to all scientific scholars who are working with Arctic, Alaskan, Canadian, or northern issues, and to reflect their interests and discoveries within the event.

The theme of the 2005 Arctic Science Conference is "Is the North that Different? Consequences of Arctic and Sub-Arctic Environmental Variation". Although the conference is open to all scientific contributions related to the North and the Arctic, this theme was chosen to emphasize environment- and weather-related research. This year's conference was organized by:

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#### **Conference Chair**

Scott Smiley, President, Arctic Division, AAAS, www.arctic.aaas.org

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Arthur Roraff, The Coordinators Inc., www.thecoordinatorsinc.com

#### **Conference Advisor**

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Jennifer Burns, Department of Biology, University of Alaska Anchorage

#### Area 2 Representative (Alaska, north of 63 degrees)

Peter Bechtel, United States Department of Agriculture

#### Area 3 Representative (Yukon, Northwest Territories, and Nunavut)

Paul Driscoll, Whitehorse, Yukon, Canada



#### Conference Program

#### **General Information**

#### **Registration Desk**

The AAAS registration staff will provide assistance with program information, audio and visual aids for sessions, and other administrative needs. The registration desk will be open:

Mon., Sept. 26 at the Kodiak Inn from 3:00 p.m. to 7:00 p.m. Tues., Sept. 27 through Thurs., Sept. 29 at Kodiak College from 8:00 a.m. to 5:00 p.m.

#### **Conference Fees**

Full Conference: \$200 Single Day: \$70 Student: \$100 Student Single Day: \$35

#### **Badges**

Each participant should obtain a badge at the registration desk prior to attending any of the sessions.

#### **Snacks and Registration Room**

Snacks will be available in the in the registration room.

#### **List of Participants**

A list of pre-registered conference participants will be available at registration.

#### **Poster Sessions**

Posters will be on display according to the following schedule:

Tues., Sept. 27 from 4:30 p.m. - 5:30 p.m. Wed., Sept. 28 from 9:00 a.m. - 4:00 p.m.

Authors will be present to discuss their material on Tues., Sept. 27 from 4:30 p.m. to 5:30 p.m. or they will designate times when they will be available for questions.

#### Lunch

The conference has scheduled a two-hour lunch break on each day. A shuttle will provide transportation between Kodiak College and various restaurants. The shuttle will leave Kodiak College beginning at 12 noon and depart every 10 minutes thereafter until the last shuttle at leaves at 1:50 p.m.

#### **Shuttle Schedule**

A shuttle bus will provide transportation between the Kodiak Inn, Buskin River Inn and Kodiak College each morning and evening. Please check with your hotel for shuttle bus schedule information.

<sup>\*</sup>All registrations include snacks on the days registered.

#### Tuesday, September 27, 2005

8:00 a.m. Registration

9:00 a.m. - 12:00 p.m. Plenary Session

Seafood Products in 20 years?

James L. Anderson, Dept. of Environmental and Natural Resource Economics, Univ. of Rhode Island

Aquaculture in 20 years?

Ronald W. Hardy, Hagerman Fish Culture Experiment Station, Univ. of Idaho

The Political Landscape of the Russian Arctic

Vitaly Churkin, Chairman of Senior Arctic Officials, Arctic Council and former Russian Ambassador to NATO

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1:30 - 4:00 p.m.	Poster Set-up		
2:00 - 4:30 p.m.	Technical Session: Climate Resources & People I Session Chair: Lawrence Duffy		
2:00 - 2:20 p.m.	Alaska Arctic and Bering Coastal Environmental Monitoring and Assessment Program (AK Arctic Coastal EMAP) an International Polar Year Effort Douglas Dasher, Alaska Dept. of Environmental Conservation		
2:20 - 2:40 p.m.	Profound declines in Aleutian populations of cormorants indicate ecosystem disequilibrium.  Douglas Causey, Dept. of Biological Sciences, UAA G. Vernon Byrd, US Fish and Wildlife Service Jeffery Williams, US Fish and Wildlife Service		
2:40 - 3:00 p.m.	Temporal variations in the diet of Arrowtooth flounder ( <i>Atheresthes stomias</i> ) and seasonal prey removals near Kodiak Island, AK.  Brian Knoth, Fishery Industrial Technology Center, UAF Robert Foy, Fishery Industrial Technology Center, UAF		
3:00 - 3:30 p.m.	Break		
3:30 - 3:50 p.m.	Nearshore Habitat Mapping in the Gulf of Alaska: Applications for Kodiak Island in a Gulf-wide Contest Susan Saupe, Cook Inlet Regional Citizens Advisory Council John Harper, Coastal and Ocean Resources, Inc. Mary Morris, Archipelago Marine Research, Ltd.		
3:50 - 4:10 p.m.	Hatch Timing and Consequences of Climate Change in Subarctic Crabs Bradley Stevens, National Marine Fisheries Service		
4:10 - 4:30 p.m.	Investigation of Ichthyophonus in Alaskan Whitefish Scott Smiley, Fishery Industrial Technology Center, UAF		
2:00 - 4:30 p.m.	Technical Session: Seafood I Session Chair: Scott Smiley		
2:00 - 2:20 p.m.	Review of Fishing Methods used in Alaska's Commercial Fishing Industry Scott Smiley, Fishery Industrial Technology Center, UAF		
2:20 - 2:40 p.m.	Electronic Noses and Applications in the Seafood Industry Jirapom Chantarachoti, Fishery Industrial Technology Center, UAF		

	Alexandra Oliveira, Fishery Industrial Technology Center, UAF Brian Himelbloom, Fishery Industrial Technology Center, UAF Charles Crapo, Fishery Industrial Technology Center, UAF David McLachlan, Canadian Food Inspection Agency
2:40 - 3:00 p.m.	Immature Pollock Roe: Chemical and Nutritional Properties Jirapom Chantarachoti, Fishery Industrial Technology Center, UAF Peter Bechtel, Fishery Industrial Technology Center, UAF Alexandra Oliveira, Fishery Industrial Technology Center, UAF Sathivel Subramaniam, Fishery Industrial Technology Center, UAF
3:00 - 3:30 p.m.	Break
3:30 - 3:50 p.m.	Food Chemistry, Subsistence Web and Nutrition Lawrence K. Duffy, College of Natural Science and Mathematics, UAF Kriya Dunlap, Dept. of Chemistry and Biochemistry, UAF
3:50 - 4:10 p.m.	Sea Pharmacy: Alaska's Next Gold Rush Brian Himelbloom, Fishery Industrial Technology Center, UAF
4:10 - 4:30 p.m.	Regional and Seasonal Study of Alaskan maricultured Pacific oyster ( <i>Crassostrea gigas</i> ) Intrinsic Quality Carey Vorholt, Fishery Industrial Technology Center, UAF
4:40 - 5:30 p.m.	Poster Displays
	Wednesday Contomber 29, 2005
	Wednesday, September 28, 2005
8:00 a.m.	Registration
8:00 a.m. 9:00 a.m 5:00 p.m.	
	Registration
9:00 a.m 5:00 p.m.	Registration Poster Displays Technical Session: Climate Resources & People II
9:00 a.m 5:00 p.m. 9:00 a.m 12:00 p.m.	Registration  Poster Displays  Technical Session: Climate Resources & People II Session Chair: Lou Rugulo  Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis
9:00 a.m 5:00 p.m. 9:00 a.m 12:00 p.m. 9:00 - 9:20 a.m.	Registration  Poster Displays  Technical Session: Climate Resources & People II Session Chair: Lou Rugulo  Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis Karen Erickson, Dept. of Political Science, UAF  Climate Change as Observed by the Gwich'in Athabascans in the Interior
9:00 a.m 5:00 p.m. 9:00 a.m 12:00 p.m. 9:00 - 9:20 a.m. 9:20 - 9:40 a.m.	Registration  Poster Displays  Technical Session: Climate Resources & People II Session Chair: Lou Rugulo  Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis Karen Erickson, Dept. of Political Science, UAF  Climate Change as Observed by the Gwich'in Athabascans in the Interior Matthew V. Gilbert, National Wildlife Federation  Ecological Characteristics of the 1970s Gulf of Alaska Climate Regime Shift
9:00 a.m 5:00 p.m. 9:00 a.m 12:00 p.m. 9:00 - 9:20 a.m. 9:20 - 9:40 a.m. 9:40 - 10:00 a.m.	Registration  Poster Displays  Technical Session: Climate Resources & People II Session Chair: Lou Rugulo  Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis Karen Erickson, Dept. of Political Science, UAF  Climate Change as Observed by the Gwich'in Athabascans in the Interior Matthew V. Gilbert, National Wildlife Federation  Ecological Characteristics of the 1970s Gulf of Alaska Climate Regime Shift Mike Litzow, Alaska Fisheries Science Center, NOAA Fisheries  Break  Exploring LRTAP Expansions to Encourage Air Quality Improvements in Targeted Source Countries with Potential Climate Co-Benefits: Could Technology Sharing and Outside Investment Provide Incentive for Arctic Climate Change Mitigation? Kimberly Herb, La Follette School of Public Affairs, Univ. of Wisconsin-Madison
9:00 a.m 5:00 p.m. 9:00 a.m 12:00 p.m. 9:00 - 9:20 a.m. 9:20 - 9:40 a.m. 9:40 - 10:00 a.m.	Registration  Poster Displays  Technical Session: Climate Resources & People II Session Chair: Lou Rugulo  Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis Karen Erickson, Dept. of Political Science, UAF  Climate Change as Observed by the Gwich'in Athabascans in the Interior Matthew V. Gilbert, National Wildlife Federation  Ecological Characteristics of the 1970s Gulf of Alaska Climate Regime Shift Mike Litzow, Alaska Fisheries Science Center, NOAA Fisheries  Break  Exploring LRTAP Expansions to Encourage Air Quality Improvements in Targeted Source Countries with Potential Climate Co-Benefits: Could Technology Sharing and Outside Investment Provide Incentive for Arctic Climate Change Mitigation?  Kimberly Herb, La Follette School of Public Affairs, Univ. of Wisconsin-

Kimberly Herb, La Follette School of Public Affairs, Univ. of Wisconsin-Madison

Tracy Holloway, The Center for Sustainability and the Global Environment,

Univ. of Wisconsin-Madison

11:10 - 11:30 a.m. Learning from the Past--ECHO 2005
Anne Jensen, UIC Science Division

11:30 - 11:50 a.m. OPEN

9:00 a.m. - 12:00 p.m. Technical Session: Seafood II

Session Chair: Peter Bechtel

9:00 - 9:20 a.m. Comparison of functional and nutritional properties of arrowtooth flounder protein

powders made using three methods

Subramaniam Sathival, Fishery Industrial Technology Center, UAF

9:20 - 9:40 a.m. Characteristics of Lipids from Heads, and Headed and Gutted Spiny Dogfish

(Squalus acanthias)

Amit Morey, Fishery Industrial Technology Center, UAF

9:40 - 10:00 a.m. Extracting high quality protein from salmon byproducts using new high pH

methodology

Peter Bechtel, USDA Agricultural Research Service

10:00 - 10:30 a.m. Break

10:30 - 10:50 a.m. Immature Pollock Roe: Chemical and Nutritional Properties

Jirapom Chantarachoti, Fishery Industrial Technology Center, UAF

10:50 - 11:10 a.m. OPEN

11:10 - 11:30 a.m. OPEN

11:30 - 11:50 a.m. OPEN

2:00 p.m. - 4:00 p.m. Alaska Ocean Observing System Symposium

Molly McCammon

Thursday, September 29, 2005

8:00 a.m. Registration

9:00 a.m. - 12:00 p.m. Technical Session: Amchitka

Session Chair: Lawrence Duffy

9:00 - 9:20 a.m. Verification and Uncertainty Reduction for Amchitka Underground Nuclear Test

Models using Bayesian Conditioning

Jenny Chapman, Desert Research Institute Ahmed Hassan, Desert Research Institute

9:20 - 9:40 a.m. Screening Risk Assessment for Possible Radionuclides in the Amchitka Marine

Environment

Richard Marty, Stoller-Navarro Joint Venture Peter Sanders, US Department of Energy Jenny Chapman, Desert Research Institute

	C. Susan Evans, Stoller-Navarro Joint Venture
9:40 - 10:00 a.m.	Radionuclides in Marine Biota around Amchitka Island Joanna Burger, Dept. of Cell Biology and Neuroscience, Rutgers Lawrence K. Duffy, College of Natural Science and Mathematics, UAF
10:00 -10:30 a.m.	Break
10:30 - 10:50 a.m.	A Vision for the International Polar Year 2007-2008 John Kelley, Institute of Marine Science, UAF
10:50 - 11:10 a.m.	First Measurements of Carbon Dioxide in the Arctic Atmosphere in Alaska: In Memory of Charles D. Keeling- 1928-2005 John Kelley, Institute of Marine Science, UAF
11:10 - 11:30 a.m.	OPEN
11:30 - 11:50 a.m.	OPEN
9:00 a.m 12:00 p.m.	Technical Session: General Science Session Chair: Scott Smiley
9:00 - 9:20 a.m.	Bioactivity Screening of the Hexane Extracts of the Selected Plants Ranilo David, Angeles University Foundation
9:20 - 9:40 a.m.	Bringing Science Education for New Civic Engagements and Responsibilities to the University of Alaska Fairbanks Lawrence K. Duffy, College of Natural Science and Mathematics, UAF Karen Erickson, Dept. of Political Science, UAF John Kelley, Institute of Marine Science, UAF
9:40 - 10:00 a.m.	Sigma Xi Alaska Wilson Award: Encouraging Careers in Research Science Lawrence K. Duffy, College of Natural Science and Mathematics, UAF
10:00 - 10:30 a.m.	Break
10:30 - 10:50 a.m.	Results of a Conservation Assessment of the Alaskan Arctic Shane Feirer, The Nature Conservancy Amalie Couvilion, The Nature Conservancy Corinne Smith, The Nature Conservancy Abby Wyers, The Nature Conservancy
10:50 - 11:10 a.m.	A Theoretical Investigation on Heat Transfer Characteristic of Nanofluids Debendra Das, Dept. of Mechanical Engineering, UAF Devdatta Kulkarni, Dept. of Mechanical Engineering, UAF
11:10 - 11:30 a.m.	Fishing Derbies: Important events for understanding Inuit land use in Nunavut, Canada Kerrie Ann Shannon, Dept. of Anthropology, UAF
11:30 - 11:50 a.m.	Study on the Scaffolds of Artificial Joints Bing Shi, Dept. of Mechanical Engineering, UAF Lawrence K. Duffy, College of Natural Science and Mathematics, UAF Hong Liang, Dept. of Mechanical Engineering, Texas A&M University
12:00 - 1:00 p.m.	Closing Session Best Paper, Best Poster Awards and Closing Remarks

#### AAAS Arctic Division Meeting History

The Arctic Division of the American Association for the Advancement of Science (AAAS) has a long and illustrious history. Founded in 1951 as the Alaska Division, the Arctic Division was established to foster scientific communication in the then rather isolated Arctic territory. The name was changed to Arctic Division in 1982 to reflect the membership's growing interest in high latitudes outside of Alaska. Most of the Division members reside in Alaska and Canada's Yukon, Northwest Territory, and Nunavut, but any AAAS member who has an interest in the Arctic may join. More information about the AAAS Arctic Division can be found online at <a href="https://www.arctic.aaas.org">www.arctic.aaas.org</a>.

#### **Previous AAAS Arctic Division Meetings**

No.	Dates	Year	Location	Chair	Theme
1	Nov. 9 - 11	1950	Washington, D.C.	John C. Reed	Science in Alaska
2	Sept. 4 - 8	1951	Mt. McKinley National Park	Laurence Irving, UA Biology Dept.	Science in Alaska
3	Sept. 22 - 27	1952	Mt. McKinley National Park	Laurence Irving, UA Biology Dept.	Science in Alaska
4	Sept. 28 - Oct. 3	1953	Juneau	Christian T. Elvey, UA Geophysical Inst.	Science in Alaska
5	Sept. 7 - 10	1954	Anchorage	Hugh A. Johnson, US Dept. of Agriculture	Science in Alaska
6	Jun. 1 - 4	1955	College	Neil W. Hosley Univ. of Alaska	Science in Alaska
7	Sept. 27 - 30	1956	Juneau	Troy L. Pewe, US Geological Survey	Science in Alaska
8	Sept. 10 - 13	1957	Anchorage	Victor P. Hessler, Univ. of Alaska	Science in Alaska
9	Sept. 2 - 5	1958	College	Robert L. Rausch, Arctic Health Res. Cntr.	Science in Alaska
10	Aug. 25 - 28	1959	Juneau	Norman J. Wilimovsky, Fisheries	Science in Alaska
11	Aug. 30 - Sept. 2	1960	Anchorage	Roger R. Robinson, US Bureau Land Mgmt.	Science in Alaska
12	Aug. 28 - Sept. 1	1961	College	John P. Hannon, Arctic Aeromedical Lab	Science in Alaska
13	Aug. 22 - 26	1962	Juneau	James W. Brooks, AK Dept. of Fish & Game	Science in Alaska
14	Aug. 22 - 30	1963	Anchorage	Allan H. Mick, AK Agricultural Exp. Sta.	Science in Alaska
15	Aug. 31 - Sept. 4	1964	College	Charles J. Eagan, Arctic Aeromedical Lab	Science in Alaska
16	Aug. 30 - Sept. 1	1965	Juneau	Richard M. Hurd, Inst. Northern Forestry	Science in Alaska
17	Aug. 29 - Sept. 2	1966	Anchorage	William Davis, Alaska Methodist Univ.	Science in Alaska
18	Aug. 28 - Sept. 1	1967	College	Peter R. Morrison, UA Inst. of Actic Biology	Science in Alaska
19	Aug. 26 - 30	1968	Whitehorse	Richard Hill, Dept. of Indian Affairs	Science in Alaska & Northern Development
20	Aug. 24 - 27	1969	College	Victor Fisher, UA Inst. Social & Econ. Res.	Change in the North: People, Petroleum & Environment
21	Aug. 16 - 19	1970	College	T. Neil Davis, Gephysical Inst.	Change in the North: UA Physical Environment
22	Aug. 17 - 19	1971	College	Laurence Irving, UA Inst. Arctic Biology	Adaptation for Northern Life
23	Aug. 15 - 17	1972	Fairbanks	Gordon S. Harrison, UA Inst. Social & Econ. Res.	Science and Policy in the North
24	Aug. 15 - 17	1973	Fairbanks	Gunter E. Weller, UA Geophysical Inst.	Climate of the Arctic
25	Oct. 18 - 20	1974	Anchorage	Willianm Davis, Alaska Methodist Unv.	Behavioral Sciences in the North
26	Aug. 11 - 15	1975	Fairbanks*	Science	Third International Conference on Port & Ocean Engineering Under Arctic Conditions (POAC)
27	Aug. 4 - 7	1976	Fairbanks	George C. West, UAF Inst. Arctic Biology	Resource Development: Processes and Problems
28	Sept. 22 - 24	1977	Anchorage	David M. Hickok, UM Arctic Environ. Info. & Data Center	Science Information Exchange in Alaska

No.	Dates	Year	Location	Chair	Theme
29	Aug. 15 - 17	1978	Fairbanks	Donald H. Rosenberg, UA Alaska Sea Grant	Alaska Fisheries: 200 Years & 200 Miles of Change
30	Sept. 19 - 21	1979	Fairbanks	Daniel B. Hawkins, UAF Geophysical Inst.	Science for Alaska
31	Sept. 17 - 19	1980	Anchorage	E. Lee Gorsuch, UAA Inst. Social & Econ. Res.	Agenda 80S
32	Aug. 25 - 27	1981	Fairbanks	John Bligh, UAF Inst. Arctic Biology	Life Sciences in the Service of Alaska
33	Sept. 16 - 18	1982	Fairbanks	Vera Alexander, UAF Inst. Marine Science.	Science in the North
34	Sept. 28 - Oct. 1	1983	Whitehorse	Arthur Pearson, Rampart Dev. Corp.	Alaska/Canada North: Neighbours in Science
35	Oct. 2 - 5	1984	Anchorage	John Davies, UAF Geophysical Inst.	Science in Public Policy
36	Sept. 27 - 29	1985	Fairbanks	Robert G. White, UAF Inst. Arctic Biology	Technology and the Scientist
37	Jun. 8 - 13	1986	Vancouver**	Richard Bushey, Yellowknife, NWT	All Disciplines
38	Sept. 24 - 26	1987	Anchorage	Thomas Morehouse, UA Inst. Social & Econ. Res.	Alaska's Resources, Alaska's Future
39	Oct. 7 - 10	1988	Fairbanks	Neal B. Brown, UAF Geophysical Inst.	Science Education
40	Sept. 14 - 16	1989	Fairbanks	Francis Williamson, UAF Inst. of Arctic Biology	Global Change
41	Oct. 8 - 10	1990	Anchorage	Thomas Newbury, US Minerals Mgmt. Serv.	Circumpolar Perspectives
42	May 16 - 18	1991	Fairbanks***	Neal B. Brown, UAF Geophysical Inst.	Circumploar Modeling of Climate Change
43	Sept. 8 - 12	1992	Valdez	Kenneson Dean, UAF Geophysical Inst.	Environmental Change: Natural and Man-Made
44	Sept. 15 - 18	1993	Whitehorse	Arthur Pearson, Rampart Dev. Corp.	Circumpolar Information Exchange: Shrinking the Circumpolar Community
45	Aug. 25 - 27 Aug. 29 - Sept. 2	1994	Anchorage Vladivostok	Rosa Meehan, US Fish & Wildlife Serv.	Bridges of Science Between North America and the Russia Far East
46	Sept. 19 - 21	1995	Fairbanks	Robert G. White, UAF Inst. of Arctic Biology	Landscapes
47	Sept. 19 - 21	1996	Girdwood	Jack Kruse, UA Inst. Social & Econ. Res.	Shaping an Unpredicatable Future: Science and Communities
48	Sept. 24 - 27	1997	Valdez	R. Ted Cooney, UAF Inst. Marine Science	Arctic Science and Resource Management: Exploring the Issues
49	Oct. 25 - 28	1998	Fairbanks	Syun-ichi Akasofu, UAF Geophysical Inst.	International Cooperation in Arctic Research: Detecting Global Change and its Impacts in the Western Arctic
50	Sept. 19 - 22	1999	Denali National Park & Reserve	Claus-M.Naske, UAF History Dept.	Science in the North: 50 Years of Change
51	Sept. 21 - 24	2000	Whitehorse	Joan Eamer, Yukon Science Inst.	Science and Community Crossing Borders - Arctic Science 2000
52	Sept. 12 - 15	2001	Anchorage****	Don Spalinger, AK Dept. of Fish & Game	2001 Arctic Science Odyssey: Exploring New Technologis and Methodologies for Arctic Science Management
53	Sept. 18 - 21	2002	Fairbanks	Terry Whitledge, UAF Inst. Marine Science	Connectivity in Norther Water: Arctic Ocean, Bering Sea, and Gulf of Alaska Interrelationship
54	Sept. 21 - 24	2003	Fairbanks	John C. Eichelberger, UAF Geophysical Inst.	Extreme Events: Understanding Perturbations to the Physical and Biological Environment
55	Sept. 14 - 16 Sept. 26 - Oct. 1	2004	Vladivostok - 1 Anchorage - 2	Craig E. Dorman, VP Research UA Statewide System	- Bridges of Science     - Human Dimensions of the Arctic Environment

<sup>\*</sup>Arctic Division co-sponsored the International Port and Ocean Engineering Under Arctic Conditions (POAC) Conference
\*\*Joint with the Pacific Division
\*\*\*Yukon College cancelled; conference moved to Fairbanks
\*\*\*\*Not held due to the tragic events of Sept. 11, 2001 at the World Trade Center and the Pentagon

#### **2005 Arctic Science Conference Abstracts**

Abstracts are listed alphabetically according to first author.

## 1. Extracting high quality protein from salmon byproducts using new high pH methodology Peter Bechtel. Subramaniam Sathivel. Alexandra Oliveira

The two major byproducts produced from salmon canning and H&G processing are heads and viscera. In addition, smaller amounts of frames and skin are produced from the processing of boneless and skinless fillets. It has been estimated that the major byproducts available in Alaska from Pacific salmon processing include over 50,000 mt of salmon heads and 30,000 mt of viscera, most of which is under utilized. Soluble and insoluble fractions from salmon head and salmon viscera can be produced using a newly developed alkali-aided extraction for use as functional animal feed ingredients. The objective of this study was to isolate both soluble and insoluble protein fractions from salmon byproducts and characterize the chemical and functional properties of the protein powders. Pink salmon (Oncorhynchus gorbuscha) viscera and red salmon (Oncorhynchus nerka) heads were used in this study.

Pink salmon viscera (PV) and red salmon head (RH) samples were collected from a commercial processing plant and stored at 20°C until thawed for protein extraction. Triplicate samples of minced samples were diluted in deionized water (1:9), homogenized, solubilized at pH 11, soluble and insoluble fractions separated by centrifugation, and the soluble fraction precipitated at pH 5.5. The freeze-dried PV-soluble (PVS) and PV-insoluble (PVIS), RH-soluble (RHS), and RH-insoluble (RHIS) fractions were analyzed for proximate composition, TBA values, lipid classes, amino acid contents, and SDS PAGE molecular weight analysis of the proteins. Evaluations of functional properties included emulsion stability (ES), fat absorption, solubility and color. RHIS, PVIS, RHS, and PVS contained 50.7%, 69.4%, 80%, and 87.2% protein, respectively. Both insoluble fractions (RHIS and PVIS) had higher fat adsorption values than PVS and RHS. All the salmon protein powders were white to lightly yellow and had desirable amino acid profiles.

Soluble protein isolates from red salmon head and pink salmon viscera have functional and nutritional properties that have potential applications in the food industries. Insoluble protein fractions could be utilized in feed industries. Other studies have indicated that high quality protein with excellent functional characteristics can be readily extracted from the frames and heads of Pollock and flat fish.

## 2. Use of Hide Digestion for the Detection and Density Determination of Biting Dog Louse (Trichodectes canis) Infestations in Alaskan Wolves (Canis lupus) Kimberlee Beckmen, Kimberly Dullen

The biting dog louse, Trichodectes canis was first detected in Alaska infecting coyotes and then wolves on the Kenai Peninsula in 1981. Treatment attempts were unsuccessful in stopping the spread of the infection and in November 1998, coyotes and wolves in the Mat-Su Valley had evidence of lice. Gross examination of wolf pelts from other areas of the state failed to identify the presence of lice until lice were found by histopathologic examination in 2004 on wolf pelts collected the previous winter near Fairbanks. This was the first time lice were demonstrated on wolves north of the Alaska Range.

To determine if lice were commonly present on wolves in the Interior but at levels too mild to detect grossly, two techniques were employed, histopathology and hide digestion with potassium hydroxide. Thirty-one wolf and one coyote pelts from different game management units were obtained, half were from areas were lice had not previously been detected. Fifteen intact pelts were subdivided into 47 to 73 10x10cm sections. The individual sections were then digested with a 5% potassium hydroxide solution and passed through a 180 micron sieve. Adult lice, larval instars and eggs were enumerated separately under a dissecting microscope. On one wolf, sections to determine spatial distribution were digested from the entire half hide. On the other hides, three survey sections were examined, dorsal back between the shoulders, groin, and neck.

Eight wolves were positive on histopathology but only one of those was negative on all 3 survey sections by digestion. An additional 3 were suspect on histopathology based on the skin lesions but lice were not visualized. On the 1/2 hide from which all sections were examined, the densities of adults and instars were approximately equal (4.2 and 4.1 lice/cm2) while eggs were less dense (2.6 eggs/cm2). The calculated density of lice including eggs was 10.9 lice/cm2.



The total burden of lice on this wolf based on the survey sections was predicted to be 78,734 lice.

With the 2 techniques employed, 11 wolves from Interior areas previously thought to be louse-free were identified with Trichodectes canis infections. Histopathology and digestion were both able to detect lice when they were not detected grossly. However, hide digestion is more sensitive and less expensive than histopathology albeit time consuming.

#### 3. Utilization of Salmon By-Products in Rural Alaska

Cindy Bower, Charlene Malemute

Marine fishing operations in Alaska may be discarding up to 60% of their landed weight as processing waste. Solutions to this problem may be found by examining traditional Alaskan methods for utilizing salmon by-products. This preliminary Salmon By-Product survey was conducted at the 2005 Yukon 800 Boat Race in Galena. Results indicated that all people surveyed ate the salmon fillets, roe, skin, and heads. Some villagers consumed the oil (47%) and a few ate the viscera (26%). Salmon were most often preserved by smoking, canning, or freezing, with about half of the respondents pickling or salting the fish instead. Approximately 25% of the salmon was fed to dogs, usually after cooking it. Fish bones and viscera were most often discarded back into the river as waste. Non-food uses for salmon by-products were less commonly reported. The results of this survey suggest that villages such as Galena, harbor a wealth of fish preservation knowledge, which may prove valuable for solving the by-product disposal problems currently found in larger fishing communities. The survey also uncovered potential small business opportunities for village-based salmon fisheries. It may be possible to utilize a greater percentage of each salmon, and at the same time increase village revenue by tapping into emerging markets such as fish oils and fish-leather.

## 4. Black-legged Kittiwake Chick Adrenal Responsiveness Correlates with Poor Colony Productivity

John Brewer, S. Dean Kildaw, Kathleen M. O'Reilly, C. Loren Buck

Seabird productivity is considered an effective measure of food abundance in marine systems. Seabirds respond physiologically to decreased food availability by increasing plasma concentration of corticosterone to promote individual survival. High concentration of plasma corticosterone in chicks promotes increased begging and is known to impact metabolic pathways to facilitate increased metabolism of lean tissue. In Chiniak Bay, Alaska, we monitored productivity (fledglings/nesting attempt) of black-legged kittiwakes (Rissa tridactyla) and sampled chicks for blood at 3, 10, 30, and 50 minutes post-capture in 2002-2004. Corticosterone levels were subsequently determined by radioimmunoassay. Productivity was greatest in 2002 (0.45) and progressively decreased to 0.24 in 2003 and 0.01 in 2004. Nestling status showed no significant effect on adrenal responsiveness, but adrenal responsiveness corresponded inversely with productivity. Chicks had significantly higher corticosterone concentrations in 2004 than in 2002 and 2003 at 30 minutes (F = 3.38, P = 0.0134) and 50 minutes (F = 8.56, P < 0.001) post-capture. Thus, chicks in a low productivity year exhibited both a more profound increase in corticosterone and a slower return to baseline, indicative of chronic stress. This study provides support for using corticosterone concentration of black-legged kittiwake chicks as an index of food availability.

#### 5. Radionuclides in Marine Biota around Amchitka Island

Joanna Burger, Lawrence K. Duffy, Michael Gochfeld, David Kosson, Charles W. Powers

Marine biota, including algae, invertebrates, fish, and seabirds were collected in 2004 from around Amchitka Island in the Aleutians, and at a reference site (Kiska Island), to ascertain the levels of radionuclides, whether there were interspecific or locational differences, and whether the levels in biota were sufficiently high to pose a health risk to top-level predators, including humans. Biota were chosen to represent nodes on the food chain, subsistence foods, and commercial seafood. The distribution of most species, including depth biota were found divers, was not significantly different for the two islands, indicating that there is a rich and diverse marine biota around Amchitka Island. There were significant interspecific difference: radiocesium was only detected in high level predators, while americium, uranium and plutonium isotopes were mainly detected in algae and invertebrates. There were significant differences among algae species, and among predator species, indicating that bioindicator selection for future biomonitoring must take into account these differences. In general, there were few interisland differences in either the percent of levels above the minimum detectable activity (MDA) levels, or in the levels themselves. However, there was a significantly higher

proportion of plutonium 239,240 isotopes above the MDA in kelp from Amchitka than Kiska, and a significantly higher proportion of radiocesium above the MDA in fish from Kiska than Amchitka. The study concluded that the foods consumed by humans from the sample region are safe with respect to radionuclides, and levels of radionuclides in the biota collected around both Amchitka and Kiska are well below published human health risk guidance levels. Our data do not suggest that radionuclides in biota collected from Amchitka are due to the three underground nuclear tests conducted at Amchitka from 1965-1971.

This research was supported by the Consortium for Risk Evaluation with Stakeholder Participation in a grant from the Department of Energy (DOE) (DE-FG26-00NT40938), with the guidance of the Alaska Department of Environmental Conservation, the U.S. Fish and Wildlife Service, the Aleutian/Pribilof Island Association, and community residents in the Aleutians and in Anchorage. This research does not necessarily reflect the views of DOE or the other stakeholders.

## 6. Profound declines in Aleutian populations of cormorants indicate possible ecosystem disequilibrium in the Near Islands

Douglas Causey, G. Vernon Byrd, Jeffrey Williams

We conducted a detailed survey of cormorants and other marine birds of the coastal ecosystems in the western and central Aleutians including the Near Islands, Rat Islands, and Andreanov Islands from 2003 to present. These data were compared to previous surveys in the same area conducted three decades ago using identical methodology. Quantitative trend analysis of population differences since 1970 showed order of magnitude declines in populations of nearshore feeding Red-faced and Pelagic cormorants (Phalacrocorax urile, P. pelagicus) in the Near Islands, but populations of Common and Thick-billed murre (Uria aalge, U. lomvia) have remained relatively unchanged. Interestingly, in the Rat Islands to the east, cormorant numbers increased slightly over the same period, as have murre populations in different colonies. Zooarcheological reconstruction of environmental change over three millennia has revealed a close association of past and present distributions to the prevailing oceanography. An example of particularly intriguing patterns over this time scale is the possible decoupling through time among urchin abundance, otter abundance, size of halibut and nearshore cottids, and in the mixed patterns of presence and abundance of on-shore, near-shore, and pelagic feeding seabirds. Our current survey data suggest that complex dynamical change in seabird ecology has occurred in recent decades and that nearshore food-webs in the Near Islands are likely in non-equilibrium.

#### 7. Immature Pollock Roe: Chemical and Nutritional Properties

Jiraporn Chantarachoti, Peter Bechtel, Alexandra Oliveira, Subramaniam Sathivel

The pollock harvest in Alaska average is over 1 million MT/ year. Valued products from this fishery include fillets, surimi, and roe. Premiums are paid to harvesters for percent mature roe yield and there are a variety of uses for this product and many properties of mature pollock roe have been determined. Immature pollock roe constitutes a significant portion of the harvest, but has less value and is often discarded or made into fish meal. The physical and nutritional properties of immature pollock roe have not been reported; which limits its potential use as a food or feed ingredient. The objective of this study was to evaluate the physical and nutritional properties of immature pollock roe and soluble and insoluble protein powders made from the immature roe. Three samples of IPR were obtained during the spring pollock harvest from a seafood processing plant in Kodiak (AK). Soluble and insoluble protein fractions were produced by heating and centrifuging IPR samples. Freeze dried samples of IPR, soluble (SP), and insoluble (IP) fractions were analyzed for proximate, fatty acid, mineral, and amino acid compositions, lipid classes distribution, physical and functional properties. Data was statistically analyzed. The protein content of freeze dried IPR, SP, and IP was 81.7, 63.2, and 83.0%, respectively. The amino acid contents of IPR and IP were similar except for isoleucine (ILE) and valine (VAL). As a generality, both IPR and IP had different contents of amino acid from those of SP. Lipid content of IPR, SP, and IP was 9.2, 9.3, and 11.1%, respectively. Palmitic acid (C16:0; 21.2%), DHA (C22:6?3; 21.2%), and EPA (C20:573; 19.0%) were the three most abundant fatty acids found in fresh IPR. Both emulsifying stability and fat adsorption capacity values for SP were significantly higher than IPR and IP (p<0.05). SDS electrophoresis of IPR indicated a major protein band with molecular weight of 103 Kda in all samples. These results indicated that the immature pollock roe had a low fat content and had a high content of good quality protein. The soluble and insoluble protein fractions made from the immature pollock roe had different functional and nutritional properties, which are of potential use in industrial applications.



#### 8. Electronic Noses and Applications in the Seafood Industry

Jiraporn Chantarachoti, Alexandra Oliveira, Brian Himelbloom, Charles Crapo, David McLachlan

Electronic nose instrumentation is a new technology that has been introduced as a rapid and accurate method in measuring the quality of various food and non-food products. The principles of the electronic nose, including details about sensor types and their comparative properties and performances, electronic nose data analysis, and their applications will be discussed. In the seafood industry, a trained human sensory panel is the traditional method used in evaluating the quality of raw and processed seafood products. This method can provide valuable descriptive information but it is subjective. Errors due to human fatigue or failure to detect a low threshold of stale compounds may occur. The electronic noses, therefore, are proposed as alternatives to human sensory panels. We tested a portable electronic nose (Cyranose 320) for evaluating quality loss in whole Alaska pink salmon (Oncorhynchus gorbuscha) stored at two temperatures. Quality changes were determined by sensory analysis of whole fish, total bacterial count for skin samples and Cyranose 320 analysis of gill and belly cavity odors. Results from sensory analysis indicated that fish were rejected at day 3 when temperature abused at 14oC and at day 12 in slush ice (control lot). Fish at either storage temperature were classified correctly 73-77% of the time when using the electronic nose for determining the degree of spoilage occurring in the belly cavity. Correct classifications increased to 85-92% of the time when specific sensors within the Cyranose 320 were selected and the data subjected to forward stepwise general discriminant analysis. A predictive model for spoilage of whole pink salmon, by analyzing belly cavity odors using this electronic nose, may be developed to replace human sensory panels.

#### 9. Radionuclides and contaminants in Arctic and subarctic regions

Margaret Cysewski, John Kelley, Douglas Dasher

Alaska shares in the common global atmosphere and ocean. Residents of Alaska remain concerned about the reports of radioactivity and other contaminants that have been found in the arctic and subarctic evironment. Alaska Natives, who are typically most dependent upon subsistence foods are now concerned that their foods may contain contaminants, such as radionuclides, that may enter the food chain.

Radionuclides are a concern to residents of the Arctic and subarctic regions as a result of past nuclear testing and nuclear waste. The North Pacific Ocean and Bering Sea regions have several potential sources of anthropogenic radionuclides:

- The former Amchitka Underground Nuclear Test Site.
- Russian North Pacific nuclear submarine facilities on Kamchatka.
- Nuclear accidents in Russia, the Former Soviet Union states, and East Asia.
- Proposals have been made to ship nuclear waste through the North Pacific and Bering Sea and locate floating nuclear power plants in the Russian Far East.

A monitoring program (ORION) was initiated by the U.S. Department of Energy to monitor radioactivity in the atmosphere at several locations in Alaska. The ORION program (Observing Radiation In Our North) also provides Alaska Native undergraduate college students an opportunity of engage in environmental monitoring and public outreach.

#### 10. A Theoretical Investigation on Heat Transfer Characteristics of Nanofluids

Debendra Das, Devdatta Kulkarni

Nanofluids are a dispersion of nano-scale metallic particles in a common fluid such as water or ethylene glycol. By adding the metallic particles to a liquid, one can enhance the thermal conductivity and the specific heat of the fluid as compared to the pure liquid itself. Both of these characteristics improve the ability of the fluids to conduct heat and also enhance their capacity to store thermal energy.

Recent research has shown that nanofluids are able to improve the heat transfer capability of a liquid substantially. Use of heat transfer fluids is very common; the two most common examples in our daily lives are the coolant in automobiles and the hot liquid in the baseboard heaters common to many homes. Additionally, many industrial plants make use of various heat exchangers, which use large volumes of heat transfer fluids. Therefore, if we can improve the heat transfer capacity – even by a small percentage – with the new types of nanofluids, then the economic and energy savings

impact on society could be immense.

In this presentation, we will summarize a theoretical analysis performed to compare the convective heat transfer coefficient of nanofluids, using copper oxide nano-particles in suspensions with pure water and ethylene glycol. We will show that nanofluids show increased heat transfer coefficient in comparison to water or ethylene glycol alone. From theoretical correlations presented in recent literature, we have calculated and prepared plots of heat transfer coefficients for copper oxide nanofluids. The results show that copper oxide nanofluids with 1% volumetric concentration in water may enhance the heat transfer coefficient by 30%. Also, the heat transfer coefficient increases with the metal volume fraction, then reaches a peak at about 30% volume concentration, after which it decreases with a further increase in concentration.

For Alaska, where household heating seasons are long, successful application of nanofluids could result in substantial energy costs savings. It will also result in smaller heating systems capable of delivering the same amount of thermal energy, thus reducing the initial cost of equipment. For example, in Lime Village, Alaska, it is possible that the existing 30kW diesel generator could save 1300 kWh/yr by pumping a nanofluid as coolant. This may save up to \$520/year. Also, our analysis shows that the payback period for nanofluid varies from 3 to 6 months. This will result in reducing CO2 & NOx emission by 1035 & 11.5 kg/yr respectively, thereby reducing the indirect impact of global warming.

## 11. Alaska Arctic and Bering Coastal Environmental Monitoring and Assessment Program (AK Arctic Coastal EMAP) an International Polar Year Effort

**Douglas Dasher** 

The Environmental Monitoring and Assessment Program (EMAP) is a United States EPA program developed with the goal to monitor the condition of the Nation's ecological resources to evaluate the cumulative success of current policies and programs and to identify emerging problems before they become widespread or irreversible. In the Arctic, where rapid climatic changes and increased resource development is occurring, the information gained from EMAP coastal assessments can contribute to a better understanding of environmental changes occurring in this regions. In Alaska, two upcoming projects, the Arctic and Bering Sea Coastal EMAP assessments, lead by the Alaska Department of Environmental Conservation in partnership with US EPA and University of Alaska, are planned for 2007 and 2008. These projects will undertake a multidisciplinary research effort to quantify spatial and temporal changes in Alaska's Arctic Coastal Ecosystems by: 1). Conducting a probability based assessment of the biogeochemical status to obtain an unbiased, quantitative understanding of the health of Alaska arctic coastal ecosystems with know confidence. 2). Utilizing a consistent set of ecological indicators, observational, sampling and analytical methods. Alaska's Arctic Coastal EMAP effort will provide a baseline for long-term assessment of the status and trends of significant estuarine and coastal resources. The EMAP approach easily integrates into proposed larger Arctic Ocean Observatory programs creating a truly comprehensive and collaborative program producing information for international, national, regional and local use.

#### 12. Bioactivity Screening of the Hexane Extracts of the Selected Plants

Ranilo David, Bernard Silvala

Plants have been known as the most prolific laboratory in nature. With the expertise in the medical technology, drug discovery has been the next venue using the nature's abundant gifts using the methods solely use as routine laboratory procedures in microbiology. An increasing number of studies have been conducted to find associations between certain plants and their health benefits, particularly their anti-bacterial and antifungal activity. Plants in the Philippine Island screened were chosen because they are believed to have saturated fatty acids that act as fungicides and their claims in the aeta community with nature's healing properties.

Different hexane extracts of the plants such as guava, jackfruit, mango, papaya and pandan revealed inhibitory effects against yeasts like C. albicans, C. glabrata, C. tropicalis and S. cerevesiae using the standard agar-cup technique and bacteria like S. aureus, Salmonella typhi, Pseudomonas aeruginosa, Klebsiella pneumoniae and Escherichia coli using agar disk diffusion method.

Phytochemical screening also revealed different active constituents of the different plants samples locally utilized by the Aetas in the Philippines.



## 13. Evaluation of Minimum Inhibitory Concentration of Amikacin and Cefuroxime to Extended Beta-Lactamase (ESBL) Producing Escherichia coli and Klebsiella pneumoniae Ranilo David. Bernard Silvala

A total of 42 isolates were collected from October,1999 to March 2000 at the Angeles University Foundation Medical Center (AUFMC) and National Kidney Institute (NKI). 24 of these were K. pnemoniae and 18 were E.coli. Isolates which revealed resistance to any of the third generation cephalosphorins or to either aztreonam or cefpodoxime were considered suspicious for ESBL production. Double-disk synergy test was performed for the detection of the presence of an ESBL in the test strains (Pai et al., 1999). MIC determination was done using the standard agar dilution with starting concentration of 20 and 10 ug/mL for Amikacin and Cefuroxime respectively. Amikacin inhibited 50 and 90% of the isolates (MIC 50 and MIC90) at 32 and 64 ug/mL respectively. The MIC of Cefuroxime at which 50% of the isolates were inhibited is one dilution higher than Amikacin, and at a concentration of 128 ug/mL, 90% of the isolates were inhibited.

## **14. Sigma Xi Alaska Wilson Award: Encouraging Careers in Research Science** Lawrence K. Duffy

The Alaska Chapter of Sigma Xi early on recognized the importance of encouraging students to gain a research experience as part of their education. The William S. Wilson Memorial Scholarship Fund was established both to honor Dr. Wilson, a great Alaskan scientist, and in response to a national concern for improvement in Science Training. The Wilson awards are intended to foster the early career development of undergraduates and graduate students as researchers. Awardees are expected to be in training with experienced scientists and to be dedicated to pursuing a career in research.

#### 15. Food Chemistry, Subsistence Web and Nutrition

Lawrence K. Duffy, Kriya Dunlap

Cautionary regulation of persistent, toxic substances is controversial because of uncertainty in ecotoxicology, especially regarding people who eat wild food. Improved nutrition, such as omega-3 fatty acids and essential amino acids are associated with subsistence foods. In the Arctic, some populations consume fish at higher levels, but mercury background levels of chronic exposure is below a concentration that can impose an increased risk to the health of newborns and the developing fetus. Hg is methylated by bacteria in fresh and marine water and concentrated through the food chain. MeHg has been associated with heart, neurological, and developmental disorders in humans. This risk of fetal brain impairment increases when the mercury concentration in maternal hair exceeds 10-20  $\mu$  g/g. Alaskans rarely had maximum Hg concentrations in hair greater than 3 ppm. Mercury can be an endocrine disruptor and MeHg can impair the immune response and affect neurogenesis. Mercury levels in several classes of vertebrates will be presented and discussed.

## 16. Bringing Science Education for New Civic Engagements and Responsibilities to the University of Alaska Fairbanks

Lawrence K. Duffy, Karen Erickson, John Kelley

The more that we are able to develop a science curriculum that encompasses biocomplexity and is culturally responsive, the more effective we will be as an agent of change for long-term stewardship in the circumpolar north. It is therefore critical that issues such as sustainability, security, disaster prevention, emergency preparedness and precaution be integrated into science teaching. Our goals were to engage UAF scientists, physical, biological and social, with students in studying unsolved public issues of the north. Students and faculty will be engaged with the community both in urban and rural environments. Initial topics under development include Environment, Resources, Nutrition, Health, Biotechnology, Radioactivity, Stewardship and Ethics. This new interdisciplinary curriculum, starting initially as baccalaureate degree minors at UAF, will strengthen civic capacity in Alaska and the Arctic by including students as civic agents in monitoring and assessing impacts of change on coupled human and natural systems.

## 17. Metabolic responses of Tanner crabs (Chionoecetes bairdi) to the effects of handling, emersion and temperature

Sonya Elmejjati, Alexandra Oliveira, Alf H. Haukenes, Scott Smiley, Bradley Stevens, C. Loren Buck

Commercially harvested Tanner crabs (Chionoecetes bairdi) in Alaskan waters are exposed to a variety of physical stressors during capture and sorting including drastic changes in temperature and oxygen availability. The purpose of this study was to characterize stress responses and subsequent recovery of Tanner crabs via metabolic parameters in two series of experiments. In the first series, changes in concentrations of hemolymph glucose and lactate were measured following 45 min of air exposure (emersion) either at 8°C or -15°C and physical injuries were recorded for up to 7 days. In the second series of experiments, rates of oxygen consumption were measured before and after cumulative periods of emersion at 8°C or -15°C and mortality rates were recorded. The 8°C emersion treatment resulted in high rates of mass specific oxygen consumption (up to 1.5 times the basal rates) immediately upon re-immersion, no changes in concentrations of glucose and increased concentrations of lactate (12.9 mg/dl from pre-stress levels of 6.9 mg/dl) 60 min after re-immersion. The -15°C emersion treatment resulted in depressed rates of mass specific oxygen consumption (0.3 times the basal rates) upon re-immersion, low concentrations of glucose compared to the 8°C treatment, and increased concentrations of lactate (13.1 mg/dl) 120 min after re-immersion. All crabs survived handling and emersion at 8°C and metabolic parameters returned to pre-stress levels during the recovery periods. In comparison, only 25% of crabs survived emersion at -15°C min and rates of mass specific oxygen consumption remained depressed. Handling, short-term emersion and subfreezing temperature are components of fishing practices that need to be considered to ensure maximum recovery and survival of post-harvest animals.

## **18. Science and Environment in the Arctic: An Interdisciplinary Framework for Analysis** Karen Erickson

The critical question for the development of science and society in the Arctic is What do we need to know in order to live well in this vast region? The presentation establishes a framework for analysis in the application of science to an understanding of environmental challenges in the Arctic. Environmental phenomena and processes might be understood in a two-dimensional framework of (1) the disciplines of science and (2) scales-of-analysis. The disciplinary perspectives, or science complexes, include the atmospheric sciences; ocean sciences; Earth sciences; and ecosystem sciences. The dimensions of scale include spatial scales, temporal scales, and organizational complexity of the organism. The use of science complexes facilitates the development of an interdisciplinary and comprehensive perspective on environmental phenomena; the scales-of-analysis dimension is essential in understanding the interactions involved, for example, in biogeochemical cycles of living phenomena. The presentation also develops a guide for sustainability by drawing on major principles of ecology and international environmental law.

#### 19. Results of a Conservation Assessment of the Alaskan Arctic

Shane Feirer, Amalie Couvillion, Corinne Smith, Abby Wyers

In 2005, the Conservancy completed an ecoregional assessment of three Arctic ecoregions: the Brooks Range, the Brooks Range Foothills, and the Beaufort Coastal Plain. The three-year project is the first comprehensive biodiversity assessment of this entire region. The assessment provides resources to support land management in a regional context. These resources include maps of species occurrences, a relative biodiversity index, and a computer model to aid in decision-making. One of the primary products is a map of areas of biological significance - areas with important values to fish and wildlife. If managed with an emphasis on biological diversity, these areas would likely make a significant difference in the ability of the region's fish and wildlife to thrive over the long term.

To learn more about the assessment, visit our website at www.nature.org/alaska.

## 20. Climate change, environmental variation and reindeer productivity on the Seward Peninsula, Alaska

Greg Finstad, Knut Kielland

A changing climate in the Arctic will influence species composition and growth patterns of vegetation communities. These changes in turn, will impact the productivity and survival of grazing animals dependent upon these communities.



It has been suggested that woody vegetation, particularly shrubs, will become increasingly prevalent in the arctic landscape and will generate negative feedbacks for reindeer and caribou production. In this paper we challenge this hypothesis with data on range characteristics and animal productivity from reindeer in western Alaska.

Herds of reindeer are grazed on defined ranges across the Seward Peninsula, Alaska. Variation in species composition, particularly the proportion of shrubs to graminoids exists across these ranges. Data from diet composition analysis and stable isotope signatures measured in reindeer indicated that the proportion of willow species to graminoids and lichen in the spring and early summer diet was higher in herds on shrub-dominated ranges (42.4% + 5.4 vs. 20% + 2.7). Moreover, calf weights were higher on these ranges (35.65 kg + .52 for males, 32.81 kg + .5 for females vs. 29.2 kg + .26 for males, 27.1 + .9 for females) suggesting a positive correlation between animal productivity and the presence of willows. The variation we have observed in reindeer productivity on different ranges may, in part, be the result of a multiplier effect manifested by the combination of an earlier and higher proportion of willows in the diet, due to both latitudinal induced environmental variation and species-specific nutritional characteristic of the forage plants. Thus, the discussion regarding foraging and production relationships in a changing environment needs to include details on both changes in community composition and species-specific variation in phenology of forage plants.

## **21.** Climate Change as observed by the Gwich'in Athabascans in the Interior V. Matthew Gilbert

The Gwich'in Athabascan assessment of Climate Change is presented by Matthew Gilbert.

## 22. Variation in Body Composition of Age-0 Walleye Pollock Related to Fish Size and Diet Change

Lei Guo, Robert Foy, Alexandra Oliveira

Ontogenetic variation of feeding habits in age-0 walleye pollock (Theragra chalcogramma) is known to occur. With increased fish size, the diet changed progressively from small copepods to large copepods, euphausiids and other mesozooplankton. These prey are characterized by significantly different chemical properties of body composition, most notably with regard to lipids which carry out various functions such as energy storage and buoyancy. The implications of these chemically different food sources on fish body composition are unknown. Information on this topic is critical to understanding juvenile fish feeding ecology and growth. In this study, age-0 walleye pollock were collected with a midwater trawl from the north side of Kodiak Archipelago in August 2004. Diet analysis was conducted for 200 individuals. Proximate composition (PC), lipid class profiles (LCP; relative content of wax esters, free fatty acids, triglycerides, sterols, partial glycerides and phospholipids) and fatty acid signatures (FA) of age-0 walleye pollock and their prey from concurrent zooplankton samples were analyzed. Relationships among fish PC, LCP, FA and fish size, diet composition were examined. Results will supply valuable information on life traits of feeding and growth about age-0 walleye pollock and other juvenile fish.

## 23. Interrelationships among temperature, metabolism and swimming performance in Pacific cod (Gadus macrocephalus): implications of changing climate

Shannon Hanna, Alf H. Haukenes, C. Loren Buck

The relative abundance of Pacific cod and other gadid species in the Gulf of Alaska appears to have changed in accordance with changes in sea surface temperatures observed over the past few decades. We wish to characterize changes in physiological performance of Pacific cod, Gadus macrocephalus, to determine if the biological constraints of this organism in a changing thermal environment could contribute to the observed changes in their relative abundance. Specifically, we are investigating critical swimming speeds and metabolic rates of Pacific cod held at different water temperatures over a range of swimming speeds. To do this, we swim cod to exhaustion in a swim flume while measuring their rates of oxygen consumption. We are currently swimming fish that are either acclimated at 4°C or at 11°C (+/- 1°C). We are also collecting before and after blood samples to analyze how these swimming trials affect the overall condition of the fish. These data will characterize the variation in energetics associated with different seawater temperatures and will allow us to quantify the differences in energy requirements necessary to sustain this organism in different thermal environments, thus allowing for future work in bioenergetics modeling. Preliminary data suggests decreased critical

swimming speed in cold acclimated fish than that of warm acclimated fish. In addition, Pacific cod demonstrate a 2-3 fold increase in metabolic rate during a swim trial.

## 24. Verification and Uncertainty Reduction for Amchitka Underground Nuclear Test Models using Bayesian Conditioning

Ahmed Hassan, Jenny Chapman

The Milrow underground nuclear test was one of three tests that were conducted on Amchitka Island, Alaska. A stochastic groundwater flow and contaminant transport model was created for the site which propagated uncertainty in input parameters through flow and transport simulations to yield an output with a wide range of uncertainty. The Consortium for Risk Evaluation with Stakeholder Participation (CRESP) sponsored field efforts in the summer of 2004, which yielded data pertaining to the location of the freshwater lens, derived from geophysical surveys on the island. These data are compared to the groundwater model input distributions for verification, and then the distributions are tightened around the new data for uncertainty reduction using a Markov Chain Monte Carlo approach. The geophysical data resulted in a transition zone location much deeper than that identified from the salinity profile at a borehole drilled on the island near Milrow ground zero. A number of scenarios are investigated in which reduction of parameter uncertainty through the use of Markov Chain Monte Carlo is evaluated using the salinity data alone, the geophysical data alone, and all data together. Due to the inconsistency between the salinity data and the geophysical logs, the use of these data sets combined does not yield a reduction of uncertainty similar to that obtained by using the geophysical logs alone. A hypothetical scenario is used where the geophysical interpretation is assumed to be consistent with the salinity data and the resulting reduction of uncertainty is found to be significant.

## **25. What are the best policy mechanisms to control climate change in the Arctic?** Kimberly Herb, Tracey Holloway

Do current and proposed climate policies effectively protect the Arctic? We present an analysis of policy alternatives in terms of their ability to reduce climate change impacts in the Arctic in a cost-effective and Pareto efficient manner. The Arctic is an especially climate-sensitive region, and we consider how protective policies should be designed in light of the Arctic's unique climatic, social, and geographic characteristics. In addition to long-lived species of greenhouse gases, we consider targeting black carbon aerosols, methane, and tropospheric ozone for mitigation that may offer immediate reductions in Arctic radiative forcing while at the same time improving air quality in source continents.

The evaluation of air pollutants in a climate context is complicated by a lack of consensus on 1) source-receptor relationships with the Arctic and the ability to consistently model those relationships, 2) estimated climatic effects of various species of aerosols, and 3) the value of targeting short-lived versus long-lived species of pollutants. We examine the ability of the Kyoto protocol and the Long Range Trans-boundary Air Pollution treaty to address the vulnerability of the Arctic to climate change and consider what alternatives or combinations might best address vulnerability of the Arctic.

#### 26. Sea Pharmacy: Alaska's Next Gold Rush

Brian Himelbloom

The next great adventure in scientific discovery is lurking beneath the seas off Alaska. Numerous macro-, meio- and microfauna have the potential to be exploited for medicinal purposes. Pharmaceuticals that could be discovered are limitless with the most promising cures or remedies undergoing biotechnology involving gene transfer, scaling-up production via bioengineering and downstream bioprocessing into purified products. A consortium will be required in providing research funds for venturing, establishing collaborations across disciplines for maximizing expertise and developing partnerships with industry for commercializing the products. This presentation will provide an overview of the potential for marine biotechnology in Alaska and the pitfalls that await the prospectors.



#### 27. Archaeology of Nuvuk: Learning from the Past--ECHO 2005

Anne Jensen

North America's northernmost village, Nuvuk, was once located at the tip of Point Barrow, Alaska. Recently, erosion has been exposing ancient human remains at an alarming rate. A survey of the area revealed that there are a large number of old unmarked graves in severe danger of erosion. A variety of cultural features, including work areas and apparent tent sites, are also threatened with erosion. Many of these features are associated with the period from time of first contract with Euroamericans through the Yankee whaling period, and some are much older.

This ECHO-funded project is involving students in all phases of a major archaeological project to excavate these threatened cultural resources, and save the data they contain about the past 1100 or 1200 years of history at Nuvuk.

Preliminary results form the summer field season will be presented. In addition, the talk will focus on how the students were able to contribute and benefit from their involvement in the project.

## 28. Northern Material Culture through International Polar Year Collections, Then and Now: In the Footsteps of Murdoch and Turner

Anne Jensen

This poster will describe a developing project based on the encyclopedic ethnological reports resulting from expeditions to Pt. Barrow, Alaska and Fort Chimo in the Ungava District (now northern Quebec) which are perhaps the most lasting product of the scientific output from the 1st IPY. Together, John Murdoch's Ethnological Results of the Point Barrow Expedition (1892) and Turner's Ethnology of the Ungava District (1894) form the intellectual bedrock of northern native studies in their respected regions. These publications are likely the only research results from the original IPY which still are consulted routinely by researchers.

We will be undertaking a modern version of these ethnological collecting projects. Using the categories developed by Murdoch and Turner, with a few additions (e.g. communications equipment, navigation devices), the project will document modern equivalents of the items Murdoch collected and their uses. Project documentation will provide a valuable resource for comparative studies of Iñupiat material culture change through time. The project's value will be enduring and will only grow through time, as happened with the material collected during the 1st IPY, leaving a legacy for future generations of researchers.

Similar programs could be carried out elsewhere. There are reportedly some collections & photographs from other original IPY sites. However, this program need not be limited to those locations. It can be undertaken in any interested community. We are interested in adding additional partners to the project.

## **29. A Vision for the International Polar Year 2007-2008** John Kelley

The International Polar Year (IPY) 2007-2008 follows in the tradition of the first polar year (1881-1883) where scientists around the world united to conduct scientific research in the polar regions. Fifty years later, a second IPY in 1932-33 led to major scientiufic discoveries. The International Geophysical Year in 1957-58 left an important legacy of discovery produced with the cooperation of 67 nations. This IPY is focused on the polar regions because environmental changes currently observed there are significant, accelerating and globally connected.

The IPY 2007-2008 will build on the legacy of the previous IPY and the IGY. It will involve all scientific disciplines and the social sciences. It will draw on the advanced technologies to enhance the temporal and spatial scales that can be addressed that was not possible in previous endeavors. Recommendations of the National Academies of Science Planning Committee for the U.S. program in the International Polar Year 2007-2008 are:

- 1. Assess large-scale environmental change and variability in the polar regions.
- 2. Pioneer new polar studies of coupled human-natural systems.
- 3. Explore new frontiers from the molecular to the planetary scale.
- 4. Use the IPY as an opportunity to establish long-term observing networks.

- 5. The U.S. should invest in critical infrastructure (both physical and human) to ensure enduring benefits for the nation and the residents of the polar regions.
- 6. Promote long-lasting partnerships and cooperation across national borders.

## 30. First Measurements of Carbon Dioxide in the Arctic Atmosphere in Alaska: In Memory of Charles D. Keeling- 1928-2005

John Kelley

Charles D. Keeling, a distinguished professor at the Scripps Institution of Oceanography, was the first to confirm the rise of atmospheric carbon dioxide by very precise infrared spectrophotometric measurements that produced a data set widely known as the "Keeling curve". Keeling's measurements of the global accumulation of carbon dioxide set the stage for today's profound concerns about climate change.

Three years after Keeling established monitoring sites at Mauna Loa, Hawaii and the South Pole, Antarctica he encouraged John Kelley at the University of Washington to establish a carbon dioxide monitoring site near Barrow, Alaska and to collaborate with the Scripps project. The site near the Naval Arctic Research Laboratory (NARL) was operational from 1961 to 1967 when it was decided that NOAAs new GMCC program would establish a long-term air monitoring program at Barrow and include carbon dioxide as one of the gases to be monitored.

The measurements at Barrow showed an annual variation in carbon dioxide much greater than observed at Mauna Loa and the South Pole, presumably due to uptake of carbon dioxide by northern hemisphere vegetation. Surprisingly, this annual variation remained nearly the same in the atmosphere near the North Pole as evidenced from the routine flask sampling program established at the various NARL sea ice research stations. At that time the secular trend was about 0.7 ppm per year increase in carbon dioxide. It is presently about 1.5 ppm per year. Carbon dioxide makes up more then 80 percent of the greenhouse gases that contribute to global warming.

## 31. Recent efforts to assess Beaufort Sea polar bear (Ursus maritimus) health: Focus on morbillivirus exposure status

Cassandra Kirk, Jeremiah Saliki, Steven Amstrup, Erich Follmann, Rhonda Swor, Todd O'Hara

In recent decades, two major stressors for polar bears (Ursus maritimus) have been identified: contaminants and climate change. A study of free ranging populations of polar bears in northern Alaska has been initiated to establish clinical (health) baseline data to monitor potential change in health status using multiple hematologic endpoints and infectious agents exposure measures (e.g., serology). As part of this study; a relatively high prevalence of serum antibodies to four morbilliviral species [canine distemper (CDV), dolphin morbillivirus (DMV), phocine distemper (PDV), and porpoise morbillivirus (PMV)] were identified. This group of viruses has been documented to cause significant disease and mortality in populations of some marine mammals. Preliminary serological data (spring of 2005) indicates 48% of the animals tested (n=64) were positive for antibodies to CDV, DMV, PDV, and/or PMV via differential serum neutralization. Each animal that was positive for either DMV, PDV, or PMV antibody presented a higher titer for CDV, suggesting the virus(es) infecting polar bears is most antigenically related to CDV. These findings are consistent with that of Garner et al. (1999) who concluded that the virus present in polar bears was most likely of terrestrial origin. Based on serological assays it cannot be determined whether these bears are infected with multiple morbilliviruses or perhaps carry a distinct strain endemic to polar bears in Alaska and/or the Arctic. Given the presence of virions in samples, proposed molecular analyses will assist further characterization of the virus(es), thus providing more information on probable sources and transmission pathways. Serosurveys of other arctic wildlife [eg. arctic fox (Alopex lagopus)] and domestic dogs (Canis familiaris) are proposed for further elucidation of the ecology of morbilliviral species in Alaska.

## 32. Temporal variations in the diet of Arrowtooth flounder (Atheresthes stomias) and seasonal prey removals near Kodiak Island, AK.

Brian Knoth, Robert Foy

Arrowtooth flounder (Atheresthes stomias) (ATF) are the most abundant groundfish species in the Gulf of Alaska (GOA) and the population increased through 2004. Due to their feeding behavior, ATF are capable of making significant impacts on commercially and ecologically important prey species in the GOA. We investigated temporal (seasonal and



inter-annual) variations in diets of ATF in the GOA, near Kodiak Island. During bottom trawl surveys conducted from 2002-2004, 760 ATF stomach samples were collected from 72 bottom trawls. Significant variations in diet composition, between seasons and years, were analyzed with a MANOVA technique. A bioenergetics model was constructed and utilized to estimate seasonal (May to August) prey consumption for each year, 2002 to 2004 in the study area. In addition, consumption estimates of select commercially and ecological important prey items were generated. For each year of the study, Walleye pollock (Theragra chalcogramma) were the most important fish prey item by weight and euphausiids were the most abundant non-fish prey item in the diet. Data generated will be useful in determining the role ATF play in structuring and regulating prey populations in the GOA ecosystem.

## 33. Mercury and Selenium: An Assessment of Contaminant and Nutrient Interactions in Bottlenose Dolphins (Tursiops truncatus)

Katrina Knott, Victoria Woshner, Randall Wells, Carla Willetto, Rhonda Swor, Todd O'Hara

Mercury (Hg) and selenium (Se) interact in an as yet unknown way that apparently counters the toxicity of Hg, and influences the nutritional and toxic properties of Se in cetaceans. Preliminary data indicated that the circulating blood concentration of total Hg in 38 bottlenose dolphins (Tursiops truncatus [italics]) from Sarasota Bay, Florida was 543.3 ppm (or  $\mu$ g/L ww). This concentration is 100 fold higher than the recommended threshold level established for humans (5.8 ppm; US EPA), below which exposures are considered to be without adverse effects. It remains to be seen, however, whether this threshold level is meaningful to a fish-eating small cetacean. The objective of this study was to monitor levels of total Hg and Se in blood from bottlenose dolphins in the Sarasota Bay population and to explore some of the biological processes involved in detoxification and functional antioxidant protection via glutathione peroxidase (GSH-Px). Levels of Hg and Se in the epidermis of dolphins will also be evaluated as a potential indicator of Hg status in circulation and other tissue concentrations.

Blood and epidermal biopsies were collected from 38 bottlenose dolphins in Sarasota Bay, Florida, during summer (June) and winter (February) 2004-2005, as part of the Dolphin Health Assessment Project (R. Wells, Project Coordinator). Mean (+/- SD) circulating levels of total Hg, whole blood total Se, serum total Se and GSH-Px activity were 543 +/- 365  $\mu$ g/kg, 0.77 +/- 0.17  $\mu$ g/g, 0.40 +/- 0.10  $\mu$ g/g and 98.8 +/- 26.5 mU/mg Hb, respectively, and did not differ by season (ANOVA; F<1.6, P>0.208). Total Hg levels in blood increased linearly with age in both male and female dolphins (F=66.5, P<0.001, R2=0.668). Serum total Se made up half of the concentration of total Se in blood and both were only marginally related to the increases of total Hg with age (F>3.6, P<0.068, R2=0.298). GSH-Px activity was linearly related to serum total Se (F=4.259, P=0.046, R2=0.325); but neither to blood total Se (F=1.97, P=0.169, R2=0.225), nor total Hg (F=0.499, P=0.484, R2=0.115).

Sarasota Bay dolphins showed the typical response of increased Hg exposure and accumulation with age. High Hg levels in the blood of bottlenose dolphins, however, seem to have a minimal effect on the Se concentrations and enzyme activity that would signify detoxification. Total Hg levels, however, provide an incomplete picture of the effect of more deleterious Hg species, such as methylmercury (MeHg), that can be at high levels in fish and biomagnify to the dolphin. Ongoing efforts are examining the amount of MeHg in the circulation of dolphins and the relation to levels of Se and GSH-Px activity. Detection of Hg species and histological examination of epidermis is also underway to compare to circulating concentrations and to detect possible indications of disease or toxicant effects such as ceroid deposits, neutrophilic infiltrate, fat cell necrosis or other associated changes. Because nutritional deficiencies are not expected in these robust free ranging animals, these data will be important when cases of suspected inadequate nutrition or Hg toxicosis are reported. Data gathered from the dolphin population at Sarasota Bay also will be compared to other studies of cetacean species, especially those residing in Arctic climes (e.g., beluga whales).

## **34.** Ecological characteristics of the 1970s Gulf of Alaska climate regime shift Mike Litzow

During the last forty years large areas of the boreal Atlantic and Pacific oceans have undergone rapid transitions between decadal-scale, relatively stable ecological states. Climate regime shifts are accepted as important external triggers for these transitions, but the underlying ecological mechanisms remain mysterious. Both top-down and bottom-up control have been proposed as mechanisms linking climate shifts to ecosystem transitions, but the strength of top-down and bottom-up control during regime shifts has rarely been evaluated. Similarly, changes in a variety of community metrics (e.g., mean trophic level, lipid content, age at maturity, etc.) have been noted following regime

shifts, but changes in these community metrics have rarely been rigorously examined. I used a time series of shrimp trawl surveys conducted by the Alaska Department of Fish and Game and the National Marine Fisheries Service during 1972-2004 to examine the ecological characteristics of the 1976-77 regime shift in the Gulf of Alaska. The data set contains 1,744 hauls conducted in seven bays on Kodiak Island and the Alaska Peninsula during July-October, and it documents the collapse of one species assemblage following the regime shift (shrimp, king crab, capelin, sandfish, sculpins), and the expansion of another (jellyfish, gadids, flatfish). The hypothesis of top-down control in the system predicts a negative correlation between the abundance of high and low trophic level animals, and I tested this prediction with catch per unit effort (CPUE) data from the 30 most common taxa in catches. I tested for bottom-up control by comparing an index of local climate (the first principal component of sea surface temperature, sea level pressure and 250 m temperature) with the CPUE of both high and low trophic level animals. I also examined temporal change in a variety of community metrics (abundance, diversity, mean trophic level, lipid content, age at maturity) coincident with the regime shift. The Gulf of Alaska community is taxonomically and functionally similar to other boreal continental shelf communities, suggesting that this analysis may provide insight into the ecological mechanisms underlying climate-induced transitions in other areas.

## 35. Seasonal Distribution, Abundance and Habitat Characteristics of Pelagic Fish in Embayments of Kodiak Island, Alaska

Mary Loewen, Robert Foy

In 1996, Congress passed the Sustainable Fisheries Act to protect the essential fish habitat (EFH) of commercially important stocks. EFH encompasses waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity, and includes associated physical, chemical and biological properties utilized by fish. Although many pelagic species utilize the nearshore environment throughout their life cycle, little is known about the influence physical factors exert on these populations. We investigated the temporal and spatial distribution patterns of Pacific herring (Clupea pallasi) and walleye pollock (Theragra chalcogramma) in the nearshore environment around Kodiak Island in relation to multiple biotic and abiotic factors. Surveys were conducted in February, May and August 2003 using a scientific echo-sounder and midwater trawl gear to measure oceanographic conditions and define EFH. Pollock and herring were found in each survey but occupied different depths of the water column. Observed fish biomass was greatest during winter, and largest concentrations were usually observed in deep, narrow arms of bays. Multivariate analyses indicate temperature, bottom depth, distance from mouth of bay, and time of year influence fish distribution. The results of this study will provide seasonal pelagic habitat information to better manage commercial fish stocks around Kodiak Island.

## 36. Screening Risk Assessment for Possible Radionuclides in the Amchitka Marine Environment

Richard Marty, Peter Sanders, Jenny Chapman, C. Susan Evans

The Long Shot, Milrow, and Cannikin underground nuclear tests were conducted in the deep subsurface of Amchitka Island in Alaska in 1965, 1969, and 1971, respectively. This Screening Risk Assessment is part of a two-part investigation of the potential for human health effects from testing at Amchitka. Groundwater modeling studies by Hassan et al. (2002) focused on the potential movement of radionuclides from the tests through geological formations to the ocean floor. This study builds on the previous work and focuses on potential transport of radionuclides in marine waters and the subsequent movement of radionuclides through the food web to human receptors. Human receptors evaluated include native Alaskans in the Aleutian Islands (exposed through their subsistence diet), and consumers of commercial catches harvested from potentially affected areas. This study is based on available data using conservative assumptions to fill data gaps and provides a conservative estimate of possible risk.

Groundwater flow paths and radionuclide migration through the subsurface were modeled for each test in early work. The groundwater model for each site included uncertainty in key parameters and presented both the mean and standard deviation of the results. The CORMIX model was used to predict dispersion within the ocean for the groundwater modeling output. The upper limit of the two standard deviations for groundwater flow and radionuclide flux were input to the CORMIX modeling to account for variability and uncertainty in the groundwater model predictions. In addition, a very conservative sensitivity case from the groundwater model was used to determine risks for the sensitivity case. The CORMIX model was used to determine the relationship between risk and ocean currents (including plume area of the entering the ocean and risk. The plume size that produced the greatest risk was then chosen as the basis for



#### calculations.

Calculations were performed in two parts. The first part calculated Radionuclide Risk Factors (RRFrs) for each radionuclide and scenario (RRFrs = BAFrs x DILs x FrCs x DIRs x INT x CMRCr). Subsequently risk for each radionuclide at each site is calculated (Riskrs= RRFrs \* concentrationrs), and results are summed to give total risk.

For each nuclide under each scenario at each site a risk value is calculated for each year up to 2000 years in the future. Calculations are done by multiplying appropriate RRF values by corresponding concentrations. Risk values are summed to give values for each year under each scenario. The highest calculated risks to human health from all exposure scenarios, cases and fluxes examined was 1.1E-10 and shows that total risks from the 19 radionuclides of concern are less than US Environmental Protection Agency's 1E-06 point of departure for Superfund Sites. Risks are also much less than applicable legal requirements from the Atomic Energy Act of 1954 (100 mrem/year, approximately 0.0001%) and represent a very small portion of the approximately 300 mrem/year dose people receive from exposure to background radiation (approximately 0.00003%).

## 37. Characteristics of Lipids from Heads, and Headed and Gutted Spiny Dogfish (Squalus acanthias)

Amit Morey, Alexandra Oliveira, Peter Bechtel, Brian Himelbloom

Total landings of spiny dogfish (Squalus acanthias) in the US for the year 2002 were 7500 MT. Although banned for commercial fishing in Alaska, spiny dogfish is caught as bycatch. Spiny dogfish has great economic value in national and international markets. Spiny dogfish meat is the most expensive shark meat in Europe. It is often consumed as fillets, and salted, diced or smoked products in Germany. There are reports of attempts to make dogfish surimi and there are markets for dried fins. In addition to these food uses, dogfish is utilized to make fish meal, silage, pet food, leather, sand paper, and fertilizer. Oils from dogfish are used as lubricants, wood preservatives, and in the textile industry. Other valued or potentially valuable constituents derived from dogfish include squalene, which is widely used in the cosmetic industry as skin softener and bactericide; alkylglycerols from dogfish liver oil, which may have medical applications; and squalamine, a broad range antibiotic. Many studies have evaluated oil from the shark liver; however, there is little information on the composition and nutritional value of by-products such as heads and headed and gutted dogfish from Alaska waters. A study was taken to evaluate the proximate composition and oil characterization of heads and the headed and gutted bodies (H&G) of spiny dogfish from Alaskan waters. Fresh spiny dogfish were obtained in Kodiak, Alaska and immediately processed into heads and H&G. Multiple batches of heads and H&G were ground to obtain replicate samples, which were frozen at 30°C until analyzed. Dogfish head and H&G samples had protein contents of 15.8% and 18.9%, respectively. Lipid contents in heads and H&G samples were 1.9%, and 9.4%, respectively. As a percent of total fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) contents were 9.2% and 15.5% for H&G samples. Omega-3 fatty acids constituted 27.0% and 22.9% of the total fatty acids in H&G and head samples, respectively. Triglycerides accounted for 75.2% of the total lipid for H&G, while phosholipid accounted for 37.9% of the lipid in heads. Dogfish heads were low in fat, while the H&G had a high fat content and is a good source of the long chain omega-3 fatty acids. These results indicate spiny dogfish could be utilized as a good nutritional source as well as used for various industrial applications.

## 38. Organic Nutrients and Essential Elements in Subsistence Use Arctic Mammals: Human Health Linkages

Sara Moses, Todd O'Hara, Gerald Bratton, Robert Taylor

Subsistence use activities in the Arctic provide a unique opportunity to study wildlife health and the linkages to human health (contaminants and nutrient pathways). A variety of arctic mammals are important food sources and a deficiency in nutrients in these animals directly impacts (lack of abundance, unthrifty animals as food, etc.) the wellbeing of the communities. Current studies aim to characterize nutrients in caribou (Rangifer tarandus), moose (Alces alces), Dalls sheep (Ovis Dalli), and spotted seal (Phoca largha) and the associated variation of nutritive quality based on health status of these animals and the processing of these animals for food (e.g., cooking, drying, smoking). Essential elements (Ca, Cu, Fe, Se, Zn), nonessential elements (Cd, Hg), and organic nutrients (six classes of fatty acids, cholesterol, Vitamin A, retinol, Beta Carotene and Vitamin C) have been analyzed in various tissues of caribou (muscle, liver, kidney; n = 18), Dalls sheep (hair; n = 39), moose (published values and TBD), and spotted seal (blubber, muscle, liver, kidney; n = 5). In addition, edible tissues were processed as typical food items (i.e. cooked) and reanalyzed for

these nutrients and compared to the raw product. This type of end-of-the-fork testing allows for not only a survey of nutrient status in these arctic mammals, but also an extension to the effects of food processing and animal health on these components. This allows for potential characterization of actual intake by subsistence users, and the subsequent human health implications (risk benefit analyses) of poorly nourished animals (deficiency) and the impacts of various food processing methodologies. Food processing resulted in significant changes in chemical composition and we note the species and tissue specific variation in nutrients. For example, when boiled, spotted seal kidney showed a 52.3% (SD = 21.2%; dry weight; n = 5) decrease in selenium content. Vitamin A in spotted seal blubber decreased by 63.4% (pooled sample; n = 5!) when rendered to produce oil. Thus, animal nutrition and the handling of wildlife based foods are critical considerations for subsistence user intake of nutrients and contaminants and maintaining food security.

## 39. Temporal and spatial variation in breeding success of black-legged kittiwakes in Chiniak Bay, Alaska

Katie A. Murra, S. Dean Kildaw, C. Loren Buck

Black-legged kittiwakes (Rissa tridactyla) are widely accepted as cost-effective bioindicators of changes in the marine environment, such as changes in forage fish availability; however, factors such as localized predation on eggs or chicks may cause small-scale spatial variation in kittiwake breeding performance and diminish their value as bioindicators. To assess the validity of using black-legged kittiwakes as bioindicators, we monitored a suite of predation-sensitive and predation-insensitive parameters of reproductive performance in Chiniak Bay, Alaska, over the course of two breeding seasons at eight colonies with overlapping foraging zones. Predation-insensitive parameters indicated forage fish were less available in 2002 than in 2001. In 2002, radio-tagged adult kittiwakes spent a greater proportion of time away from the colony, had longer foraging trips, and growth rates of chicks were lower (0.58±0.02se, 4.3hr±0.3se, 15.3g/day±1.91se, respectively) compared to 2001 (0.51±0.02se, 2.6hr±0.4se, 16.1g/day±1.76se, respectively). Predation-sensitive parameters indicated significant spatial variation existed among colonies. Extensive predation at a few colonies caused significantly reduced hatching success that lead to lower overall productivity in 2002 (49%) than in 2001 (73%). While predation may have been facilitated by less availability of forage fish (food-stressed kittiwakes are more likely to leave their nests unattended), these changes in reproductive performance may be more indicative of spatial differences in predation pressure than temporal differences in forage fish availability. Therefore, in areas where predation exists, we conclude that it is imperative to directly measure predation, or monitor predation-insensitive parameters when using seabirds as bioindicators of the marine environment.

## 40. Comparison of functional and nutritional properties of arrowtooth flounder protein powders made using three methods

Subramaniam Sathivel, Peter Bechtel

Arrowtooth flounder (Atheresthes stomias) is a large flatfish found in great abundance in Alaska waters. Although abundant and easily harvested it is seldom harvested due to the properties of its flesh. One major obstacle to utilizing the fish is the presence of very potent enzymes that soften the flesh during cooking, making it unpalatable to many consumers. The question of what to do with the arrowtooth flounder remains. Methods of processing are needed to convert the fish into more marketable forms. Our previous studies have shown protein derived from arrowtooth flounder fillets (AF) is an excellent source of high quality protein that can have uses in product coatings, mayonnaise, and as food and feed ingredients. A number of methods have been used to extract fish protein; however comparisons of the proteins made from AF using the different methods are lacking. The objective was to compare functional and nutritional properties of fish protein powders made from AF fillets using three methods, which were heating and fractionation (HF), enzymatic hydrolysis (EH), and alkali protein extraction (AE).

Heated fractions were made from frozen AF that were thawed, minced, mixed with water, heated at 85oC for 60 minutes, and centrifuged to obtain soluble (HFS) and insoluble protein (HFISP) fractions. Enzymatic hydrolysis fractions were made by using alcalase at 50°C for 50 min, and then centrifuged to obtain soluble (EHS) and insoluble (EHIS) fractions. The alkali protein extraction procedure used mince that was diluted and homogenized in deionized water (1:9), pH adjusted to 11, centrifuged to obtain insoluble protein (AEIS) and the soluble protein (AES), which was precipitated at pH 5.5. All fractions were freeze-dried and analyzed for proximate composition, nutritional and functional properties.

The AES (89.6%) and EHS (84.8%) powders had higher protein contents than other protein powders (72.6-89.6%). The essential amino acid content of all protein powders samples was higher than that recommended by FAO/WHO



(1990) for human adults. All protein powders samples were rich in K, P, Mg, and Ca. HFS and EHS had the highest emulsion stability and nitrogen solubility values. The EHS, HFIS, and HFS had higher emulsion stability than that of EHIS, AES, and AEIS. SDS electrophoresis indicated AES and AEIS had discrete protein band patterns, while EHS, EHIS and HFS were substantially hydrolyzed.

These results indicate that a variety of protein powders can be made from AF fillet that have different chemical and functional properties, which can have a variety of uses.

## 41. Nearshore Habitat Mapping in the Gulf of Alaska: Applications for Kodiak Island in a Gulfwide Context

Susan Saupe, John Harper, Mary Morris

In 2001, we initiated a project to quantify coastal habitats in the Cook Inlet and Kenai Peninsula areas based on ShoreZone mapping methods that had previously been completed in British Columbia and Washington State. This led to the development of a ShoreZone mapping protocol for the Gulf of Alaska and, during the last five years, many local, state, and federal agencies, and non-governmental organizations have partnered to map much of the northern Gulf of Alaska coast.

This ShoreZone project mapped biological and physical characteristics of the coastal nearshore environment using low-tide aerial video imagery as the primary source of information. Additional information was provided by a geomorphologist and coastal ecologist onboard the aircraft who provided detailed information about specific features. The survey information was systematically entered into a database that was linked to digital shorelines to provide georeferenced data on morphology, mobility, exposure, and biotic assemblages (biobands), allowing maps to be produced from database queries of various shoreline features. Detailed information about shoreline habitats was obtained during vessel-based surveys as verification of aerial survey data as well as to provide detailed species association data for the mapped biobands.

We will describe ShoreZone methods, imagery, data, and applications by focusing on recent surveys around Kodiak and surrounding islands. Results from the 2002 aerial surveys and the 2005 vessel-based surveys will be presented, including a discussion about potential implications of previously undocumented beds of the nearshore kelp, Macrocystis integrifola.

## **42. Fishing Derbies: Important events for understanding Inuit land use in Nunavut, Canada** Kerrie Ann Shannon

To understand Inuit land (and water) use it is necessary to also account for whole families participation in procurement activities. In this paper I will explore fishing derbies in Coral Harbour, Nunavut, Canada. Fishing derbies are annually held events, which involve the participation of women, men, children and elders. The derbies are significant not only for subsistence resource gain but also for social and cultural reasons. In this paper I will examine the significance of fishing derbies in understanding Inuit land use.

#### 43. Study on the Scaffolds of Artificial Joints

Bing Shi, Lawrence K. Duffy, Hong Liang, Thomas Kuhn

Many people with arthritis feel very strongly that changes in the weather affect the level of pain they experience in their joints, particularly cold and damp. Cold and dump weather can make arthritic joints feel more painful and stiffer than usual. Patients with arthritis living in Alaska will suffer more than those living in the warm area since the winter in Alaska is long and cold. The long periods of darkness in the Arctic during winter compounds the stress. Non-surgical treatment, such as anti-inflammatory drugs, walking aids, and support braces offer some relief, but artificial joint replacement is needed when the cartilage that lines the joint deteriorates. Traditionally, the patient will need a Total Joint Replacement surgery. The artificial joints have the longest service time about 8-12 years and a patient can have only two surgeries in his/her whole lifetime. In this study we investigated a new approach: tissue engineering method to study the scaffolds of artificial joints. The goal of this research is to design a bioengineered matrix. The matrix would be implanted to the damaged cartilage area of the arthritis patients and cells will grow and cover the damaged area. We

investigated scaffold material for cellular compatibility. The study shows that some candidate matrix materials studied are biocompatible (carbon polymers) and others were toxic (Ni). Future directions include culturing stem cells on new carbon materials.

## **44.** Hatch Timing and Consequences of Climate Change in Subarctic Crabs Bradley Stevens

Crab species in the Gulf of Alaska have a variety of reproductive strategies. One aspect that may contribute greatly to reproductive success or failure is the timing of hatching. In six species investigated to date, three different patterns have emerged. Red and blue king crabs Paralithodes camtschaticus and P. platypus (both anomurans), at continental shelf depths, have protracted hatching, requiring 30 days per crab. Primiparous females have longer embryonic development times, and hatch earlier in the year, whereas multiparous females hatch progressively later with age. Hatching of a discrete population may take place over a period of 3 months. In contrast, hatching by Tanner crabs Chionoecetes bairdi (a brachyuran), from similar environments, requires only 6 days per crab, and is synchronized with the spring tide cycle. Differences in embryonic development and hatching time between primiparous and multiparous females in this species are not as great. The intertidal anomuran Hapalogaster mertensii hatches larvae in April, but does not produce a new clutch until September, and only carries embryos for about 7 months, as opposed to the king and Tanner crabs that extrude new clutches immediately after hatching, and carry them for 11-12 months. Timing of embryonic development and hatching are greatly influenced by temperature and probably contribute strongly to survival of larvae and juveniles. Hatch timing may be a mechanism by which periodic or long-term climate change directly influences population variability.

## 45. Development of techniques for cultivation of Pribilof Islands blue king crab Paralithodes platypus.

Bradley Stevens, Sara Persselin

The blue king crab (BKC, Paralithodes platypus) was a valuable commercial fishery species in the Bering Sea. In the late 1990's populations declined to levels considered too low to support commercial fishing, stimulating interest in their early life history. Prior to conducting research on juvenile crab biology, it was necessary to develop techniques for cultivating them in the laboratory. In this experiment, we tested the effects of diet, temperature, and rearing density on survival of larvae to the first crab stage.

Four different diets were tested including: UNFED zoea were not fed in order to determine if they could survive on stored yolk (lecithotrophic); THAL treatment was fed with Artemia nauplii enriched by feeding with diatoms Thalassiosira nordenskioeldii; Art +THAL treatment was fed with unenriched Artemia plus live Thalassiosira; ISO 6 was a control diet of Artemia enriched by feeding with frozen Isochrysis paste. All diets were tested at 6 C, and a density of 10 zoea per liter, with 6 replicates per treatment. The ISO diet was also tested at 3 C (ISO 3) and 9 C (ISO 9), and at densities of 20 (ISO 20) and 40 (ISO 40) zoea per liter.

Crab zoeae were cultivated in PVC tubes with 625  $\mu$ m mesh on the bottom. Each tube was placed in a glass beaker filled with filtered and UV-sterilized seawater. Tubes (with larvae) were transferred to beakers with fresh seawater daily, and fed via pipette. Dead larvae and molted exuviae were removed daily, and complete counts were made at weekly intervals until all larvae molted to first stage crabs.

Survival on the A+THAL diet (91.7%) was significantly higher than all others, whereas UNFED larvae died within two weeks. Survival in all other treatments was not significantly different. Survival decreased slightly with increasing temperature, but not significantly. Density had no significant effect on survival, but final mean density (16 zoeal-1) was similar in the ISO 20 and ISO 40 treatments suggesting that a maximum carrying capacity for these conditions had been reached. Length of development to the first juvenile crab stage (C1) was significantly longer (109 d) at 3 C than at 6 C (70 d), but did not decrease further at 9 C.

CONCLUSIONS: Blue king crab larvae can be cultivated with high survival using the proper diet. Larvae are not lecithotrophic and must be fed. A temperature of 6 C is optimal for survival and length of development. These results will be used to produce larger numbers of juvenile crab for laboratory research. In addition, these techniques could be modified for use in enhancement of wild crab stocks.



## 46. Winter Breeding and the Reproductive Challenges Faced by Non-Hibernating Alaskan Redbacked Voles (Clethrionomys rutilus)

Kalb Stevenson, April Brennan, Ian van Tets

Arvicoline rodents (lemmings and voles) are small, non-hibernating mammals that play important roles as primary consumers in high-latitude environments. They maintain a high body temperature through the winter, employing neither hibernation nor torpor, and invest large amounts of energy into thermoregulation. Despite this, evidence of winter breeding has been documented for several species. How and why this occurs is unclear, but winter breeding is likely to play a role in the dynamic population cycles of these animals which, in turn, affect the structure of Alaskan plant communities, the survival of their predators, and the populations of other non-predatory wildlife. Our aim is to identify the environmental, nutritional, and physiological challenges to reproduction faced by a non-hibernating, high-latitude arvicoline rodent, the northern redbacked vole (Clethrionomys rutilus), and to determine how this species overcomes them to breed in winter.

We will achieve this aim by testing five hypotheses. We will test that red-backed voles are income breeders that use energy directly from dietary intake to fuel reproduction, that correlations exist between seasonal changes in vole diet selection and plant fiber, nutrient, protein, or energy content, that thermal acclimatization by red-backed voles includes significant seasonal changes in field metabolic rate (FMR), that the reproductive condition of free-living voles correlates with both a phototaxic cue (daylength) and a chemotaxic cue (the plant secondary compound, 6-MBOA), and that voles that are not responsive to environmental cues (winter-breeding) exist in southcentral Alaska.

This research will improve the current understanding of the physiological mechanisms facilitating winter-breeding and survival in an abundant and ecologically important high-latitude taxon whose members do not use either torpor or hibernation. It will provide new details about the environmental physiology of arvicoline rodents and contribute valuable information about the diet, energetics, breeding strategies, and reproductive cues of one species towards the debate over what factors control population cycling. Finally, it will help game managers to better predict the effects of climate change on populations of these animals' populations whose numbers strongly influence predator, non-predator, and plant populations throughout the world.

#### 47. The Wildlife Toxicology Laboratory: Contaminants, Health Status and Nutrition

Rhonda Swor, Todd O'Hara, Katrina Knott, Cassandra Kirk, Sara Moses, Ben Meyer

A new group informally known as the Wildlife Toxicology Laboratory (WTL) is located at the University of Alaska in Fairbanks (UAF, PI-Todd O'Hara). This group is largely supported by the NIH INBRE program (NCRR 2P20RR16466-04) as well as the Center for Alaska Native Health Research (CANHR), North Slope Borough (NSB), and World Wildlife Fund (WWF). The laboratory's capabilities include mercury analysis (total and organic), basic or proximate composition (water, lipid, calories), enzyme kinetics, microwave digestion, atomic absorption spectroscopy for essential and non-essential elements, and histology. The laboratory is also developing a battery of immune function assays along with basic clinical hematology, serology and chemistry for determining both condition and health status of polar bears (Ursus maritimus) and arctic fox (Alopex lagopus). Most wildlife contaminants studies focus on tissues that are of scientific interest (e.g., biomagnify a contaminant) and not from the perspective of a consumer (food items). One major focus of the WTL encompasses both animal health and subsistence use perspectives by intensively examining caribou (Rangifer tarandus), spotted seal (Phoca largha) and sheefish (Stendous leucidhthys) caught by fishers and hunters in Kotzebue, AK for consumption. We are evaluating the affect of food processing impacts on nutrients and contaminant concentration in food (balanced assessment) on the above subsistence food species. The WTL is also developing clinical (molecular and biochemical) assays and in vitro immune bioassays for determining health and immune status of free ranging Alaska polar bears in relation to emerging contaminants and pathogens in cooperation with the USGS.

Arctic fox (captive) will be evaluated as a model to determine bioavailability and changes in tissue composition using terrestrial and marine food items thus exploring its utility for use as a model for the general chemical feeding ecology studies for both humans and polar bears. The specific aims of this initial study are to determine the general bioavailability of essential and non-essential elements and stable isotopes of carbon and nitrogen enrichment to the arctic fox from select subsistence food items: moose (lower trophic source) and spotted seal (higher trophic source). The Arctic fox model will be examined for the suitability of laboratory studies to address immune, reproductive and disease transmission issues related to contaminants and infectious agents (zoonoses) in the arctic Alaska human and wildlife food web.

## **48. Synthetic Aperture Radar (SAR) Online Searchable Bibliography** Julia Triplehorn, Don Atwood

The Alaska Satellite Facility in conjunction with the Geophysical Institute's Mather Library, has developed a bibliography of Synthetic Aperture Radar (SAR) publications that is available on the Internet. This online searchable resource serves as a comprehensive one-stop-shop for citations to journal articles, proceedings, abstracts, dissertations, and books describing applications and techniques of SAR. References have been gathered from more than 40 online indexes for the time period 1999-2004. Users can search the bibliography by author, title, periodical, and keyword with emphasis on specific disciplines and applications. Specific examples include Boreal forests, Disasters, Glaciers, Hydrology, Ice navigation, Mining, Permafrost, Target recognition, and Volcanoes.

This searchable bibliography offers one of the most comprehensive information sources for those interested in exploring SAR.

## 49. Regional and Seasonal Study of Alaskan maricultured Pacific oyster (Crassostrea gigas) Intrinsic Quality

Carey Vorholt, Alexandra Oliveira, Charles Crapo, Brian Himelbloom, Quentin Fong, Ray RaLonde

Oyster farming is a new and growing enterprise for Alaska's coastal economy. This 12-month study evaluated changes in the intrinsic quality of commercially harvested oysters from three different regions in Alaska to determine optimal harvest strategies to maximize oyster producers' returns.

Oysters were sampled monthly from farms located in Prince William Sound (PWS), Kachemak Bay (KB) and Southeast Alaska (SE). For each region, oyster quality and nutritional value was assessed by measuring proximate composition, glycogen content, fatty acids (FA) profile and three methods for condition index. Protein content ranged from 7.5% to 8.9% for all samples investigated. Average protein content between summer and winter oysters were 8.5g/100 g tissue and 8.1g/100 g tissue, respectively. PWS oysters had little protein variation from September to May with an almost 1% increase during summer months. SE oysters had larger variation in protein content that appeared unrelated to season conditions. KB oysters showed a decrease in protein during spring months. Glycogen content was highly dependent on the elapsed time between harvest and shipment arrival dates. Glycogen decreased slightly during winter months. Condition index could not predict oyster quality as effectively as proximate composition and glycogen content. In PWS, KB, and SE oysters, a decrease in polyunsaturated FA was recorded during the summer with a decrease of saturated FA during winter months. Omega-3 FA levels were high throughout the year and ranged from 40.9% to 48.2% of total lipids, regardless of region. Eicosapentaenoic acid and docosahexaenoic acid ranged from 17.7% to 24.9% and 12.9% to 20.9%, respectively. Omega-6 FA content ranged through the year from 3.3% to 7.6%, regardless of farm location throughout the year. Our results suggest that Alaskan maricultured oysters have expected seasonal differences with slight regional variation.

#### **50. The Arctic Research Consortium of the United States**

Wendy K. Warnick, Helen V. Wiggins, Sarah Behr, Alison York

The Arctic Research Consortium of the United States (ARCUS) is based in Fairbanks, Alaska and was formed in 1988 as a nonprofit member consortium of educational and scientific institutions that have a substantial commitment to research in the Arctic. ARCUS provides leadership in advancing knowledge and understanding of the Arctic by serving as a forum for planning, facilitating, coordinating, and implementing disciplinary and interdisciplinary studies of the Arctic; acting as a synthesizer and disseminator of scientific information on arctic research; and encouraging and facilitating the education of scientists and the public about the needs and opportunities of research in the Arctic.

#### 51. Teachers and Researchers Exploring and Collaborating (TREC)

Helen V. Wiggins, Janet Warburton, Sarah Behr, Timothy Anzelmo

TREC is an educational research experience in which K-12 teachers participate in arctic research, working closely



with scientists, as a pathway to improving science education through experiences in scientific inquiry. Now in its second year, TREC builds on the scientific and cultural opportunities of the Arctic to link research and education through topics that naturally engage students and the wider public. In addition to arctic field research experiences, TREC supports teacher professional development and a sustained community of teachers, scientists, and the public through workshops, Internet seminars, an e-mail listserve, and teacher peer groups. Funded by the National Science Foundation Office of Polar Programs, TREC uses online outreach elements to convey the research experience to a broad audience. While in remote field locations, teachers and researchers interact with students and the public through live calls from the field and online journals with accompanying photos.

## 52. What's for dinner? Using stable isotope analysis to investigate diet composition in tufted puffins.

Cory T. Williams, S. Dean Kildaw, C. Loren Buck

Central-place foraging theory predicts that adults of species that do not regurgitate food to their young should maximize the rate of energy provided to their offspring and minimize the cost of chick-provisioning by selecting large, high-quality prey items to feed their nestlings. However, when feeding for self-maintenance, adults might maximize their rate of energy intake by selecting smaller prey items that occur in highly predictable and dense aggregations. In 2003 and 2004, we used stable isotope analysis of whole blood samples to compare the trophic positions of adult and nestling tufted puffins (Fratercula cirrhata) in Chiniak Bay on Kodiak Island, AK Stable isotopes of N suggest that adults feed primarily on invertebrates prior to egg-laying, but gradually transition to a piscivorous diet during chick-rearing. In 2003, chick-rearing adults had  $\delta$  15N values that were slightly (+0.19), but significantly (P<0.01) enriched compared to nestlings, whereas in 2004,  $\delta$  15N values were significantly higher in chicks(+0.38; P<0.01). These results suggest that adults were not feeding on lower trophic level invertebrates during the chick-rearing period as was predicted by central-place foraging theory. However, consumption of invertebrates may increase during years where forage fish availability is reduced.

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